

REMARKS

In the present Amendment, Applicants have amended claim 1 to more appropriately define their invention. Upon entry of the Amendment, claims 1-11 remain pending.

In the Office Action dated April 3, 2003, the Examiner rejected claims 1-4, 6-9, and 11 under 35 U.S.C. §103(a) as being unpatentable over Wu (U. S. Patent No. 6,511,916) in view of Tu et al. (U. S. Patent No. 6,147,005), and rejected claims 5 and 10 under 35 U.S.C. § 103(a) as being unpatentable over Wu and Tu et al., and further in view of Lin et al. (U. S. Patent No. 6,376,366). Applicants respectfully traverse these rejections.

Embodiments of the present invention are in general related to a method for preventing misalignment of a photoresist during a dual damascene manufacturing process. Particularly, claim 1 recites, among others, "providing an insulating layer; providing a photoresist on the insulating layer; . . . depositing a layer of carbon-fluoride material over the tops and sidewalls of the photoresist; after deposition of the carbon-fluoride material, anisotropically etching the insulating layer to create at least one opening."

Regarding the rejection of claims 1-4, 6-9, and 11 as being unpatentable over Wu in view of Tu et al., Applicants submit that these references, taken alone or in combination, do not teach or suggest each and every element of the present invention.

Applicants first note that, contrary to the Examiner's allegation on page 2 of the Office Action, Wu does not describe a method for improving misalignment of photoresist. Instead, Wu describes a method for removing photoresist and polymer residual during a damascene process. See ABSTRACT.

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Moreover, referring to Figs. 4C and 4D, Wu describes that “a second photoresist layer 470 is formed on the second inorganic dielectric layer 430, and . . . is defined Afterward, another dry etching process is performed by way of using the second photoresist layer 470 as another etching mask to etch through the etching stop layer 420 and the first inorganic layer 410 After finishing the dry etching process a second polymer layer 480 is formed on the surface of the second photoresist layer 470.” Col. 4, lines 49-62. Assuming, according to the Examiner, Wu’s polymer 480 corresponds to Applicants’ claimed “layer of carbon-fluoride material,” which Applicants do not concede, Wu at least fails to teach “after deposition of the carbon-fluoride material, anisotropically etching the insulating layer to create at least one opening, wherein the tops and sidewalls of the photoresist are covered with the layer of carbon-fluoride material and not etched by the anisotropic etching,” as required by claim 1. As described above, Wu apparently teaches that polymer 480 is formed contemporaneously with the dry etching of first inorganic layer 410 or second inorganic layer 430. See col. 4, lines 28-62 of Wu. Therefore, Wu actually teaches away from the present invention as recited in claim 1.

Tu et al. describes a method of forming dual damascene structures, wherein “[an] in-situ polymer layer is formed on the semiconductor substrate.” Col. 3, lines 21-22. Referring to Figs. 3A-5B, “[f]irst, a photoresist layer 22 is formed on the top surface of the second dielectric layer 8. Then, . . . the second dielectric layer 8 is etched by using the photoresist layer 22 as an etching mask. . . . Then, . . . a polymer layer 24 is formed . . . on the second dielectric layer 8, the photoresist layer 22 and the etch stopping layer

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6. . . . Then, . . . the polymer layer 24 is used to serve as an etching mask for etching the first dielectric layer 4." Col. 4 line 4 - col. 5, line 40.

Clearly, Tu et al. fails to teach or suggest at least "depositing a layer of carbon-fluoride material over the tops and sidewalls of the photoresist; after deposition of the carbon-fluoride material, anisotropically etching the insulating layer to create at least one opening, wherein the tops and sidewalls of the photoresist are covered with the layer of carbon-fluoride material and not etched by the anisotropic etching," wherein the photoresist is provided "on the insulating layer," as required by claim 1. In other words, Tu et al. fails to cure the above-mentioned deficiencies of Wu.

In addition, claim 6 recites, among others, "providing an insulating layer; providing a first photoresist over the insulating material; . . . anisotropically etching the insulating material to form at least one groove in the insulating material; removing the first photoresist; providing a second photoresist over the insulating material; . . . anisotropically etching the insulating material to form at least one opening, wherein the at least one opening is aligned with the at least one groove."

In the Office Action, the Examiner considered Wu's first inorganic dielectric layer 410 and second inorganic dielectric layer 430 as corresponding to Applicants' claimed insulating layer. Office Action, page 2. Applicants respectfully traverse the Examiner's position because Applicants' claimed insulating layer is a single layer, and cannot correspond to both first dielectric layer 410 and second dielectric layer 430.

Moreover, neither of first inorganic dielectric layer 410 and second inorganic dielectric layer 430 is etched "to form at least one groove" and etched "to form at least one opening." See Wu, col. 4, lines 14-67. Therefore, Wu fails to teach or suggest at

least "providing an insulating material; . . . anisotropically etching the insulating material to form at least one groove in the insulating material; . . . anisotropically etching the insulating material to form at least one opening, wherein the at least one opening is aligned with the at least one groove," as recited in claim 6. The fact that Wu teaches etching each of first inorganic dielectric layer 410 and second inorganic dielectric layer 430 only once actually shows that Wu teaches away from claim 6 of the present invention. See col. 4, lines 14-67.

For reasons already set forth above, Tu et al. does not teach or suggest at least "providing an insulating material; . . . anisotropically etching the insulating material to form at least one groove in the insulating material; . . . anisotropically etching the insulating material to form at least one opening, wherein the at least one opening is aligned with the at least one groove," as recited in claim 6. Therefore, Tu et al. does not cure the above-identified deficiencies of Wu.

As a result, Wu and Tu et al., taken alone or in combination, fail to teach or suggest each and every element of the present invention as recited in claims 1 and 6. They actually teach away from claims 1 and 6. Therefore, one skilled in the art would not be motivated to combine Tu et al.'s teachings with Wu, resulting in the present invention. There would have been no expectation of success in doing so, in view of such teach-away references.

In view of the above, Applicants respectfully submit that claims 1 and 6 are patentable over Wu in view of Tu et al., and claims 2-4, 7-9, and 11, which depend from ~~claims 1 and 6, respectively, are also patentable over Wu and Tu et al., at least~~ because of their dependencies from an allowable base claim.

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Regarding the rejection of claim 5 under 35 U.S.C. § 103(a) as being unpatentable over Wu and Tu et al., further in view of Lin et al., Applicants submit that Lin et al. does not teach or suggest at least “depositing a layer of carbon-fluoride material over the tops and sidewalls of the photoresist; after deposition of the carbon-fluoride material, anisotropically etching the insulating layer to create at least one opening, wherein the tops and sidewalls of the photoresist are covered with the layer of carbon-fluoride material and not etched by the anisotropic etching,” as recited in independent claim 1, from which claim 5 depends. See Figs. 2a-2i of Lin et al. In other words, Lin et al. fails to cure the above-mentioned deficiencies of Wu and Tu et al. Therefore, claim 1 is patentable over Wu and Tu et al. in view of Lin et al., and claim 5 is also allowable under 35 U.S.C. § 103(a) at least because of its dependency from an allowable claim 1.

Similarly, regarding the rejection of claim 10 under 35 U.S.C. § 103(a), Lin et al. does not teach or suggest each and every element of claim 6, from which claim 10 depends, and does not cure the deficiencies of Wu and Tu et al. with regard to the patentability of claim 6 as set forth in the above. Therefore, claim 10, which depends from allowable independent claim 6, is patentable over Wu and Tu et al. in view of Lin et al. at least because of its dependency from an allowable base claim.

In view of the foregoing remarks, Applicants respectfully request the reconsideration and reexamination of this application and the timely allowance of the pending claims 1-11.

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Respectfully submitted,

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